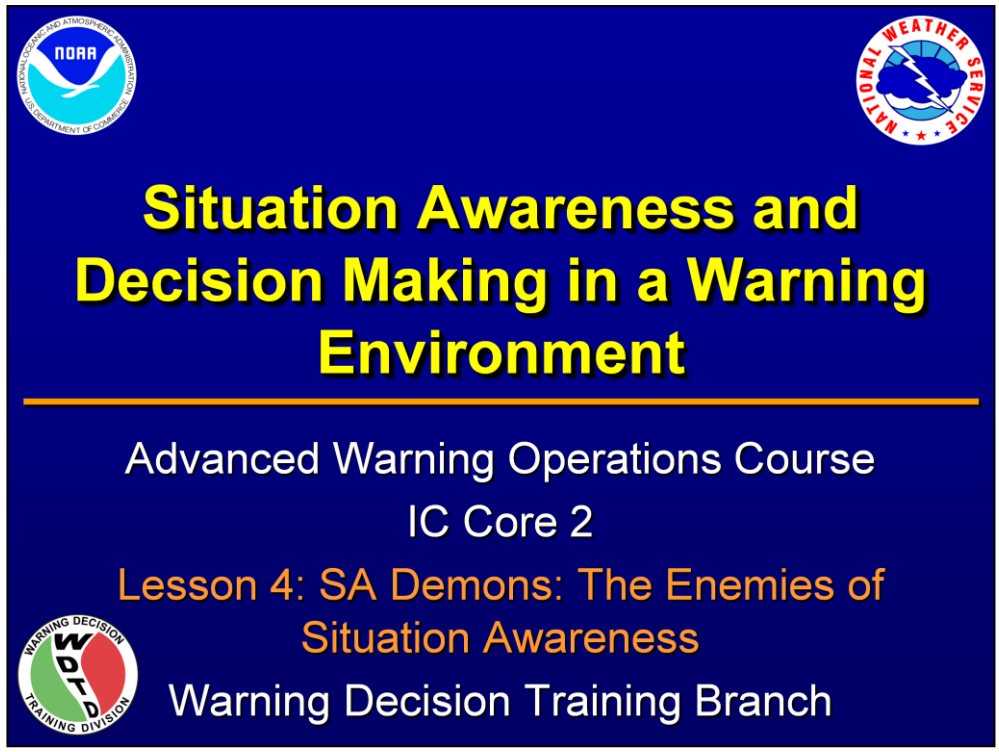


Lesson 4 will focus on the SA Demons, which are the enemies of Situation Awareness.

Lesson 4: SA Demons: The Enemies of SA

Learning Objective

- Identify the SA demons and how they can inhibit SA.

"There is nothing so likely to produce peace as to be well prepared to meet the enemy."
George Washington

The Learning Objective for Lesson 4 applies to the SA demons, identifying them as well as how they can inhibit SA.

Lesson 4: SA Demons: The Enemies of SA

Performance Objective

1. As part of post-event analysis, determine the role that SA (good or bad) at the three levels played in the warning decisions that were made.

The Performance Objective for Lesson 4 applies to post event analysis during this course as well as after completion. Though they are not tested formally, understanding SA demons and their impact as part of post event analysis will improve your ability to build and maintain good SA in future events.

SA Demons Overview

- Attaining and maintaining good SA is a function of
  - Human performance and processing
  - The complex "domain" of the forecast office during a warning event
- SA Demons are factors that inhibit SA

Summarizing the previous lessons of Core 2, getting and maintaining good SA is dependent on how humans perform in the complex domain of the warning environment. SA Demons are elements to look for in this environment.

SA Demons Overview

- Attentional Tunneling
- Requisite Memory Trap
- Workload, Anxiety, Fatigue, and Other Stressors (WAFOS)
- Data Overload
- Misplaced Salience
- Complexity Creep
- Errant Mental Models
- Out-of-the-Loop Syndrome

"Designing for Situation Awareness" Endsley, Bolte, and Jones

There are eight different SA demons, each of which will be defined and examples provided. The concept of SA demons comes from a book by Mica Endsley, "Designing for Situation Awareness".

SA Demons: Attentional Tunneling

- Good SA dependent on switching attention among multiple data sources
  - "scanning behavior"
- Locking in on one data source is attentional tunneling
  - SA is lost by dropping your scanning behavior

In most domains, good SA requires regularly switching your attention among multiple data streams. In highly dynamic domains like warning operations, the number of data sources is very high and their relative importance changes. Attentional tunneling is becoming overly fixed on certain data sources to the exclusion of others. A sometimes tragic example from everyday life is making calls on a cell phone while driving. Losing your SA on the driving task for even a few moments can sometimes have terrible consequences.

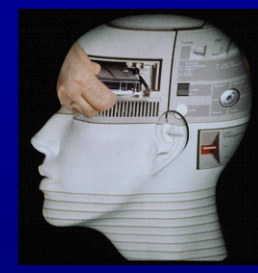
Attentional Tunneling NWS Example

- Expectations are low for thunderstorms
- Warning forecaster busy working equipment problems
  - Doesn't notice the BWER in a strong developing thunderstorm
  - Unwarned tornado

- Attentional tunneling on the equipment caused loss of SA on developing convection

In this example, the day's expectations were for a low probability of thunderstorms. Thunderstorms did develop in the midst of some equipment problems. The warning forecaster was part of the group working the problem. Since his attention was tunneled toward the equipment, he missed a BWER in a particularly strong thunderstorm. The storm did produce a damaging tornado.

SA Demons: Requisite Memory Trap

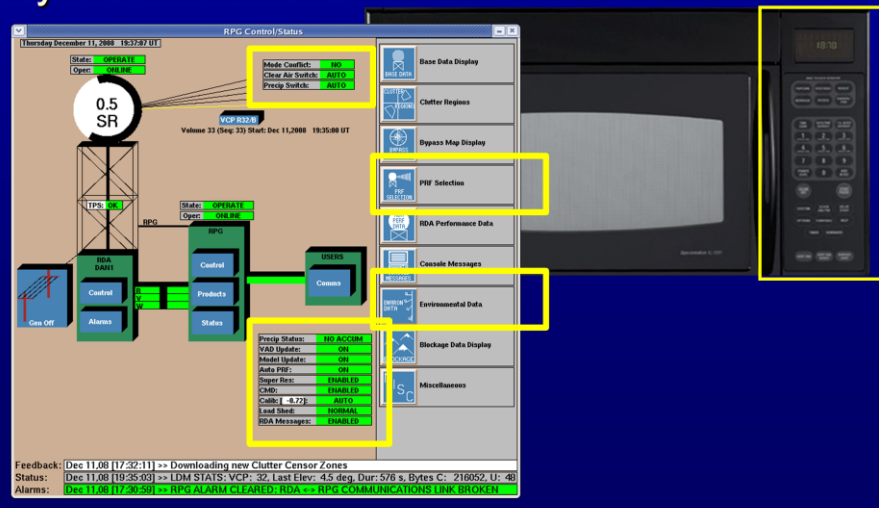


- Working memory holds chunks of data to support SA (level 2)
  - It is a limited resource for anyone!
- When system requires lots of memory just to use it…
  - Does not support data interpretation
  - "System" can be technology or how humans interact based on organizational structure

Working or short term memory is the part of our cognitive load that "caches" chunks of data. Good SA (level 2) is dependent on holding sufficient data chunks to apply a conceptual model. Research has shown that working memory can be better developed, but is still a limited resource. Technology that is designed in a way that requires significant memory just for operating the system erodes working memory.

SA Demons: Requisite Memory Trap

- Do you ***remember*** what ***all*** these buttons ***do***?



Systems that require “getting out the manual” for operations beyond the baseline are common in everyday life. Most microwave ovens have a myriad of features that aren’t used because the design requires too much memory. With the WSR-88D, there are many tasks that will optimize radar performance, but are difficult to do during warning operations.

SA Demons: Requisite Memory Trap

- Some mitigation possible
- Pre-event anticipation and preparation
  - Radar optimization
    - Potential VCPs
    - Algorithm parameter changes (e.g. Z-R relationship)
  - AWIPS configuration
    - Adjust/create procedures
- Adequate staffing to address the unexpected

Anticipation of events and setting parameters before the event begins can partially mitigate this demon. This is particularly important for tasks that require too much memory to be done on the fly. Examples include adjustments to AWIPS procedures, RPS lists, considering potential VCPs, and radar algorithm parameter changes.

SA Demons: Workload, Anxiety, Fatigue, and Other Stressors

- Stress and anxiety are ***likely*** issues in the warning environment
  - Lives are at stake (sometimes office staff and/or family members)
  - Shift work and chaotic environment
  - Humans often misjudge their own ability to cope

- WAFOS reduces a person's ability to process information

Workload, Anxiety, Fatigue, and Other Stressors (WAFOS) are human conditions common to dynamic domains. WAFOS is likely to be a significant issue in warning operations and should be monitored and adjusted as best possible. Humans usually assume that they can "keep on going" despite stressful circumstances. The warning coordinator can often identify someone who needs a break well before the individual would know.

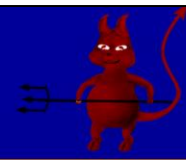
For example, during a historic tornado event, one of the warning forecasters, "Joe", was working a supercell with a large tornado that passed through his neighborhood. Phone communications were down and Joe could not reach his family. Joe did not ***ask*** if he could leave to check on his family…the warning coordinator ***told*** him to go. It took awhile for Joe to find out, but his family survived despite significant structural damage.

SA Demons: Workload, Anxiety, Fatigue, and Other Stressors

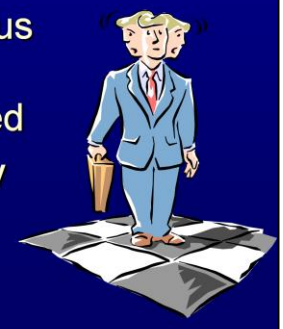
- WAFOS worsened by
  - Ambiguous roles and responsibilities
  - Poor communications among team members
  - Face Threat

There are non-meteorological factors that affect WAFOS as well, taxing attention and working memory. Ambiguous roles and responsibilities and poor communication among team members will worsen the “distraction” that WAFOS provides. Face threat is a particularly damaging hindrance to team communication, and ***all*** staff must be aware of the potential for face threat to get in the way.

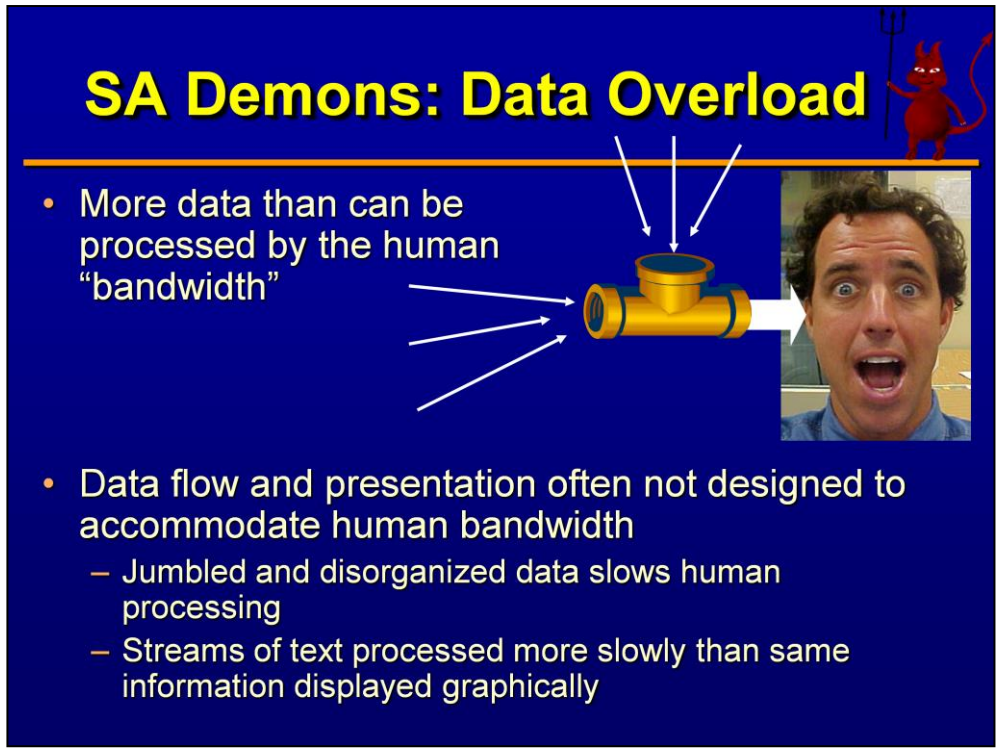
WAFOS
NWS Example



- Severe thunderstorm watch with moderate risk
  - Poor understanding of conceptual models
  - Storm interrogation procedures not in place
- Lack of warning coordinator
  - Roles and responsibilities ambiguous
  - Coordination and communication (internal and external) compromised
- Wording of products did not really convey the threat



This example resulted in significant hail and wind damage in some unwarned counties. A number of factors came together to raise the WAFOS to the point of hindering storm recognition, internal and external communications and conveying the severity of the threat.

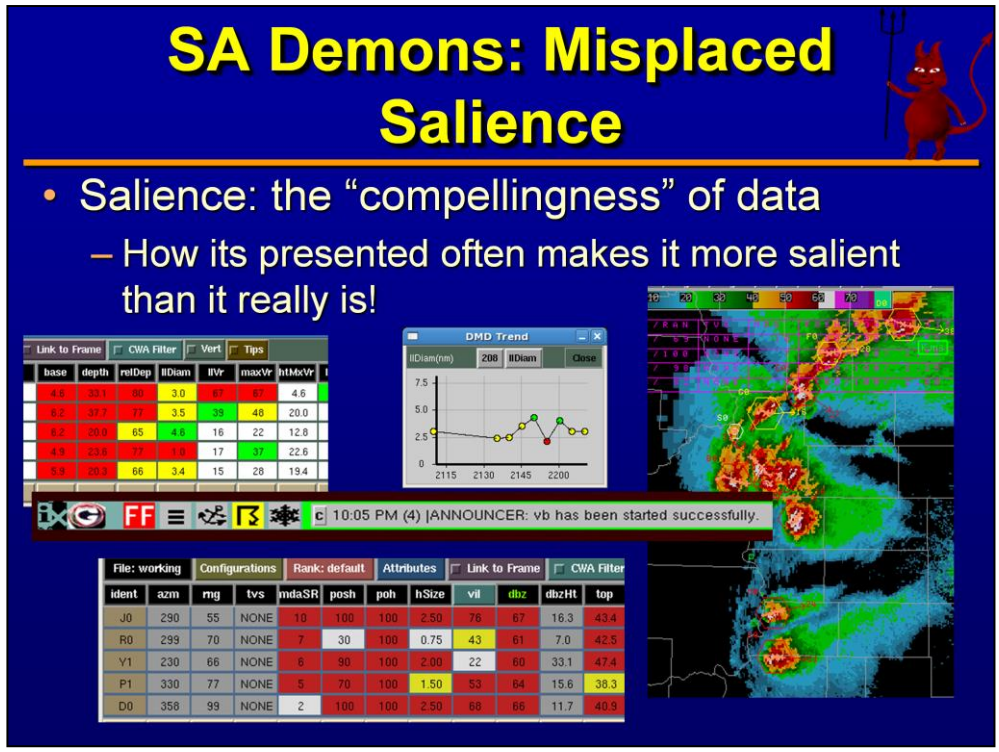


Data Overload is a frequently cited problem in our culture. In warning operations, it can significantly inhibit good SA. Humans have a limited bandwidth, yet systems (technology and communications) are often not designed to accommodate this limitation.

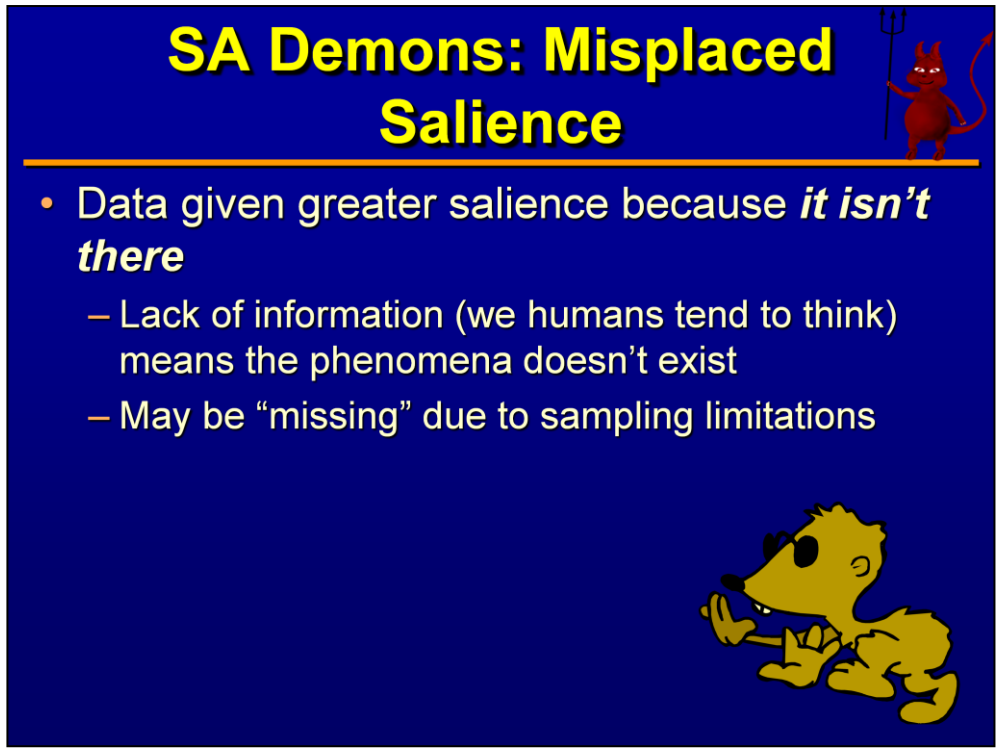
SA Demons: Data Overload

- Example of mitigating this demon: Monitor warning status graphically

One example of mitigating this demon is to graphically display current warnings and the number of minutes remaining for each warning. In this example, it is part of an overall situation awareness display.

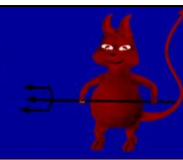


You are probably all too familiar with red boxes and banners and the associated audio alarms. It is often left to the operator to investigate and determine which of these alarms is actually relevant. Misplaced salience with these alarms is a typical example.



A more subtle example is misplaced salience on the ***lack*** of information. We humans tend to assume that the absence of information means that the phenomena doesn't exist. For example, a lack of spotter reports from a storm is often interpreted to mean that the storm isn't producing hail or strong winds.

Misplaced Salience
NWS Example

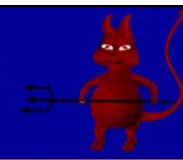


- Supercell had previously produced a tornado
- Desire to improve office performance metrics
  - Looking for surface boundaries to enhance tornadic potential, but not seen in data
- Strong meso on radar, but no information below radar horizon: spotter reports “missing”

- Radar signatures and storm history given low salience

In this example, there was a supercell that had previously produced a tornado. The office staff wanted to improve their warning statistics, and were looking hard for clues from the environmental data. Surface boundaries were not seen in the data and assumed not to be there, reducing the tornadic potential. Though the radar showed a strong mesocyclone, spotter reports were not available, interpreted to mean that the storm was not tornadic. In both cases, the lack of data was interpreted to mean that the phenomena was not there. The radar signatures and storm history were given too little salience, and the storm produced an unwarned tornado.

Misplaced Salience
NWS Example



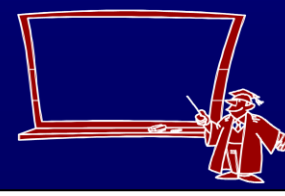
- Missed flash flood event
  - Ground truth arrived too late
  - Officials in affected county usually very pro-active, but not heard from for this event
  - Tendency to think no report = nothing happening
    - This assumption may not even be a conscious one!

AWOC Core 3 RCA

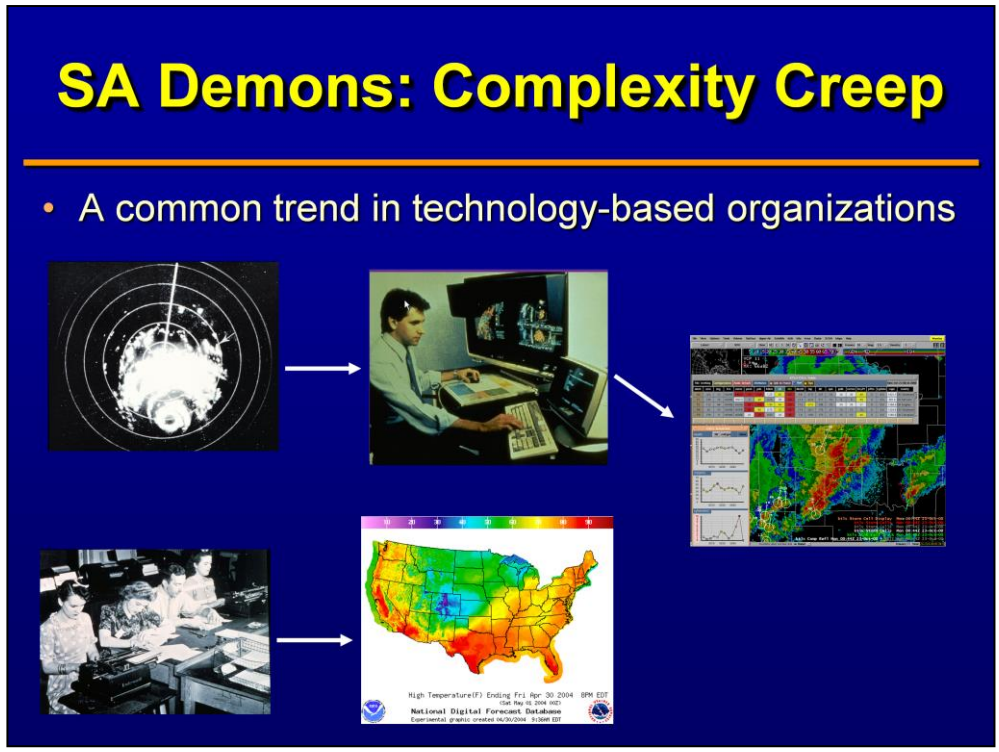
This was a case of a missed flash flood, mainly due to the lack of ground truth. This occurred in a county where the officials are usually very pro-active, but not this time.

SA Demons: Complexity Creep

- Slows down perception of information (level 1)
- Primarily undermines understanding (level 2) and projection (level 3)
- Additional training is often proposed as the solution to this problem….



Complexity creep is a long term problem with many science and technology driven organizations and has an impact on all three levels of SA. Training is typically proposed as the solution to this problem, though often by those who aren't going to produce the training or those who will complete it!



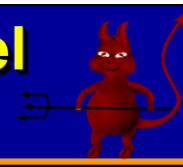
Complexity creep is a common trend in technology-based organizations. Here are a couple of trends in the NWS in the past several decades.

SA Demons: Errant Mental Models

- Incomplete understanding of mental model hinders
  - Comprehension (level 2 SA)
  - Projection (level 3 SA)
- Wrong mental model? May incorrectly interpret data
  - Prevents or slows shift in SA
- "People tend to explain away conflicting cues to fit the mental model they have selected" (Endsley)
- Be alert for data that seems conflicting…

Errant mental models can have an impact in different ways. Though the appropriate conceptual model may have been anticipated, an incomplete understanding of that model may hinder comprehension and projection (level 2 and 3 SA). If the wrong model is anticipated, the data may be incorrectly interpreted. Humans have a tendency to explain away cues in the data that conflict with the mental model that they have selected. An extreme example is an underlying assumption that "tornadoes don't happen here". The following slides have a couple of examples of conflicting data that is "explained away".

Errant Mental Model
NWS Example



- Expectation: marginally severe storms with small hail, strong winds
- No hail reported, yet high radar rainfall estimates assumed to be hail contaminated
  - Storms missing gages; did not seek other ground truth
- Storms over area of new urban development
  - Detention ponds and other design elements assumed to be sufficient for runoff
- ***Result: flash flooding in small basin areas***

In this example, the primary threat expected is small hail and strong winds. No hail is reported, yet high radar rainfall estimates are assumed to be hail contaminated. There's not much gage data, but no-one sought additional ground truth. The storms were over an area of new urban development and detention ponds were expected to be sufficient for runoff. The mental model of hail and winds was used to explain away the potentially important cues of high radar rainfall estimates over areas of new urban development.

Errant Mental Model
NWS Example

- Unwarned flash flood event
  - Severe weather believed to be dominant threat
  - Workload resources committed to severe weather monitoring/warnings
  - Initial public reports of localized flooding are "trivialized"

AWOC Core 3 RCA

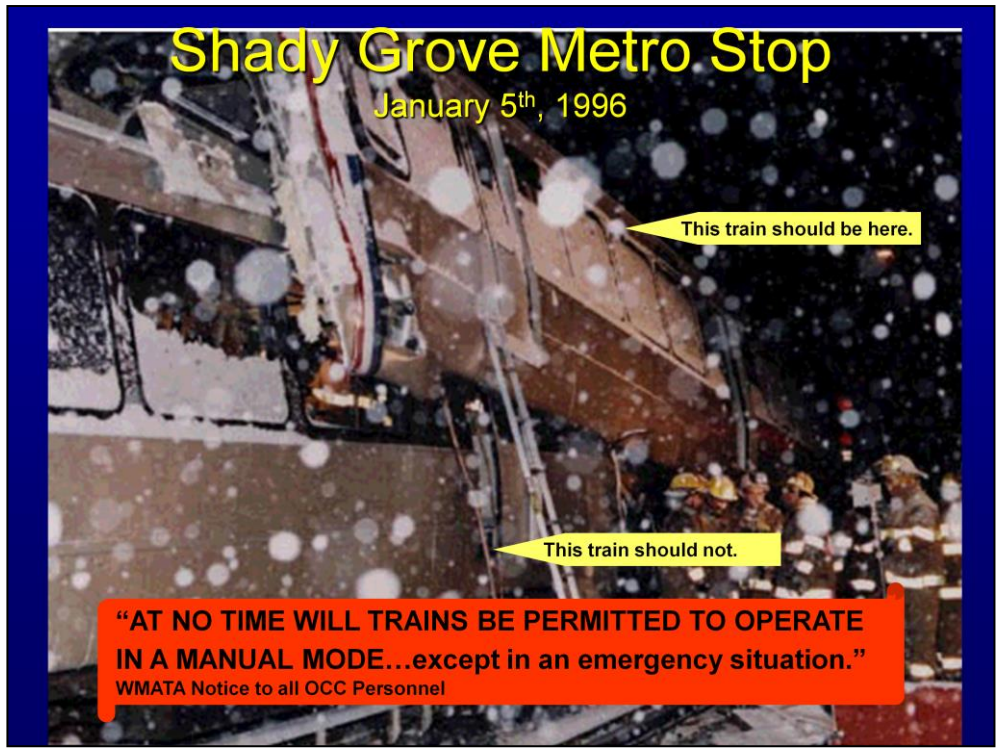
This unwarned flash flood event came from an AWOC Core 3 RCA. The mental model of the team was based on the expectation of severe weather, but not flash flooding. The workload was distributed to address the severe weather threat and the team was very focused on that task. Unfortunately, public reports of localized flooding were "trivialized". This is an example of the human tendency to "explain away conflicting cues", when what is really needed is a shift in the mental model.

SA Demons: Out-of-the-Loop Syndrome

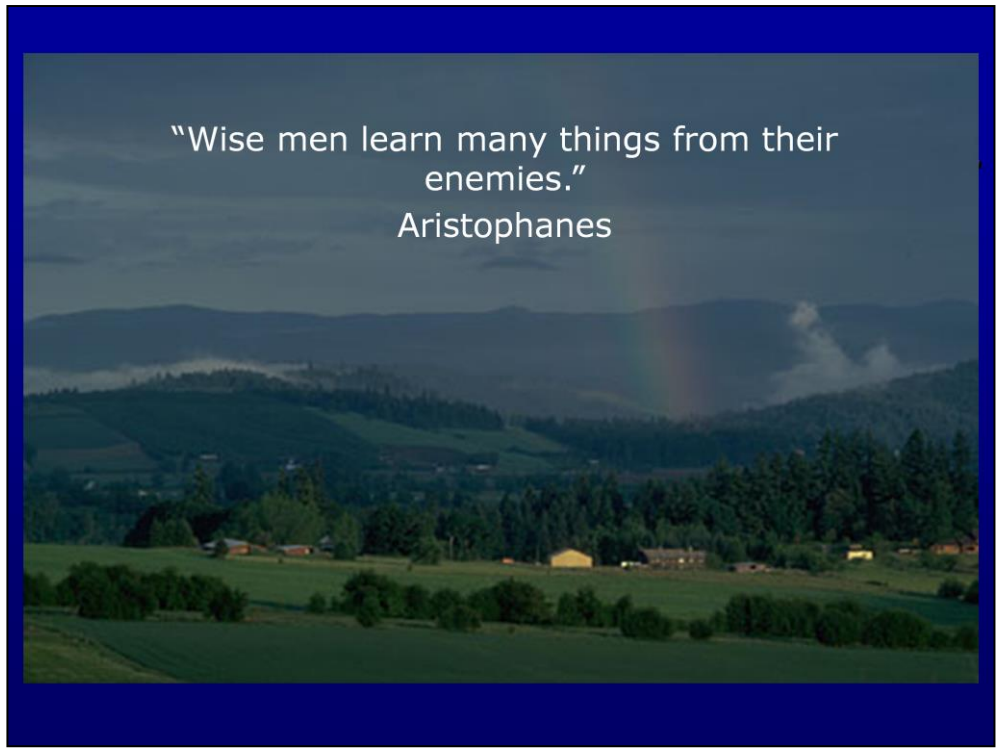
- Automated systems that don't involve the human until there is a problem
- Assumption is automating routine tasks will minimize "human error"
  - Sometimes true, but other times…

- Automation does not eliminate error
  - Changes the types of errors that are made

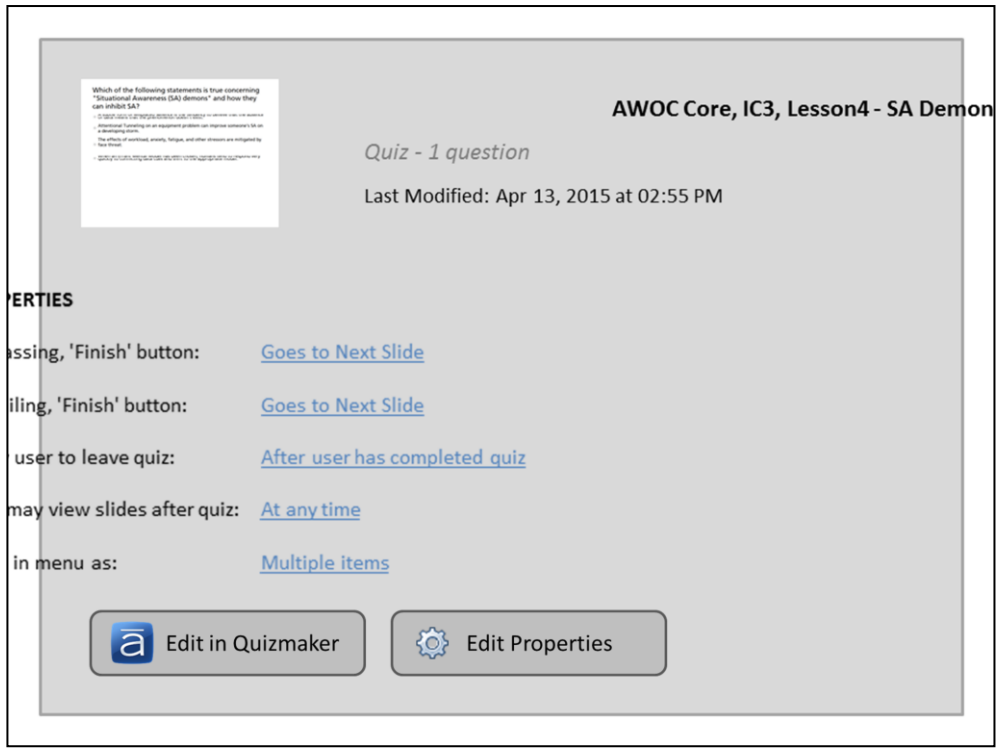
In many domains, much of the "routine" work that humans do forms the foundation of their skills. Automation of routine tasks is sometimes a good thing, but there is risk. In some cases, an attempt to minimize human error has sometimes resulted in automating as much as possible of the routine tasks, leaving the human to intervene only when there is a problem. This approach can result in a loss of the skills that are built and maintained by doing the routine tasks. It also may not allow the human enough time to respond, even when they know what to do.

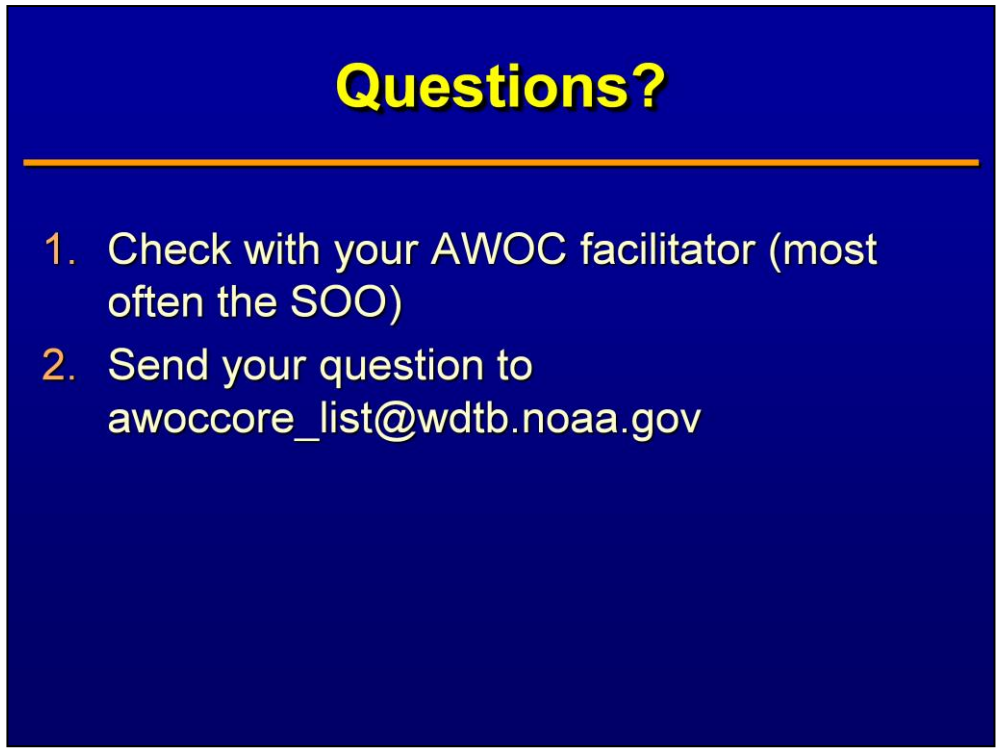


Under the assumption that letting the computers run the trains would minimize wear on parts, train operators were not allowed to run the trains manually, unless there was an emergency. This policy impairs an operator's ability to assess a problem, react quickly, and be sufficiently skilled to react effectively. Automation resulted in a train traveling too fast for the snowy conditions. The operator was unable to react quickly enough to avoid this accident, which unfortunately killed him.



Aristophanes says it best…


Which of the following statements is true concerning "Situational Awareness (SA) demons" and how they can inhibit SA?
AWOC Core, IC3, Lesson4 - SA Demon
Quiz - 1 question
Last Modified: Apr 13, 2015 at 02:55 PM
ERTIES
assing, 'Finish' button:
Goes to Next Slide
iling, 'Finish' button:
Goes to Next Slide
user to leave quiz:
After user has completed quiz
may view slides after quiz:
At any time
in menu as:
Multiple items
Edit in Quizmaker
Edit Properties



If you have questions about the material from IC Core 2, first check with your AWOC facilitator (most likely your SOO). If your AWOC facilitator cannot answer your question, please send an email to awoccore_list@wdtb.noaa.gov.

References for IC Core 2

- Toward a Theory of Situation Awareness in Dynamic Systems; M. Endsley, 1995, Human Factors and Ergonomics Society
- Design and Evaluation for Situation Awareness Enhancement. M.R. Endsley, 1988: Proceedings of the Human Factors Society, 32nd annual meeting, Santa Monica, CA
- Situation Awareness in Team Performance: Implications for Measurement and Training. 1995 Human Factors 37(1).
- Designing for Situation Awareness, M. Endsley, B. Bolte, and D. Jones; Taylor & Francis

References

- Guidelines for Situation Awareness Training: C. Prince, NAWCTSD/UCF/FAA Partnership for Aviation Training
- Defensive Driving. Wait, Make That Defensive Flying; J. S. T. Ragman, Flying Safety, May 2002
- 1998 Railroad Accident Report Collision of Washington Metropolitan Area Transit Authority Train T-111 with Standing Train at Shady Grove Passenger Station, Gaithersburg, Maryland January 6, 1996, NTSB
- Sources of Power: How People Make Decisions, G. Klein; MIT Press
- Intuition at Work, G. Klein; Doubleday

References

- Highest Duty, My Search for What Really Matters; C. Sullenberger, J. Zaslow; HarperCollins